NP about Blue Light from CN-NC vs IEC TR 62778:2014

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1.1 NP ABOUT BLUE LIGHT FROM CN-NC

- Background
  - ✓ Full title: Measuring methods of blue-light characteristics and related optical performances for visual display terminal
  - ✓ Proposed by: CN-NC
- Scope
  - ✓ This document specifies measuring methods which contains blue-light characteristics and optical performances of visual display terminal, such as computer monitor, TV, etc.

Note 1: This document is taken IEC 62471:2006 Photobiological safety of lamps and lamp systems as normative reference

Note 2: This document is providing measurement methods only

1.2 MEASUREMENT METHOD

- Measurement object
  - ✓ Performance of visual display terminal
- Measurement environment(s)
  - ✓ Performed in dark room
  - ✓ Temperature: 15ºC ~35 ºC
  - ✓ Humidity: 20 %RH to 80 % RH
  - ✓ Atmospheric pressure: 86 kPa to 106 kPa
- Measurement Methods
  - ✓ Measurement distances
    - Mobile display terminal: 30 cm
    - Computer monitor: 50 cm
    - TV: 3 x TV screen high
  - ✓ Step 1: Select 9 measurement points on visual display terminal
  - ✓ Step 2: Get L_b for each measurement
  - ✓ Step 3: Calculate L_B for each measurement points
  - ✓ Step 4: Calculate B_R for each measurement points
  - ✓ Step 5: Get each average values of L_b, L_B and B_R

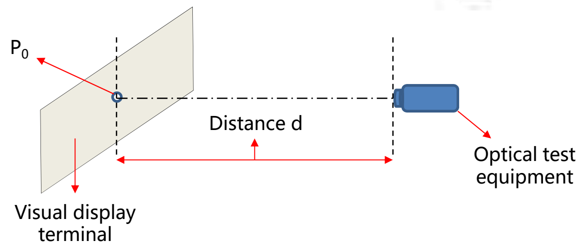

Figure 1-Optical measurement schematic diagram of visual display terminal

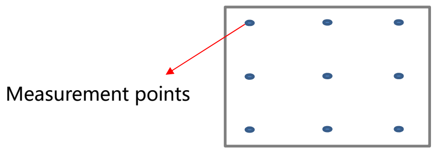

Figure 2-Measurement Points

1.3 CRITICAL FORMULAS

BOE

- Formula 1: Blue-light radiance

$$L_b = \int L_\lambda \cdot \Delta\lambda$$

L_λ—Spectral radiance $W \cdot m^{-2} \cdot nm^{-1} \cdot sr^{-1}$
$\Delta\lambda$—Wavelength bandwidth nm

- Formula 2: Blue-light weighted radiance

$$L_B = \int L_\lambda \cdot B(\lambda) \cdot \Delta\lambda$$

L_λ—Spectral radiance $W \cdot m^{-2} \cdot nm^{-1} \cdot sr^{-1}$
$B(\lambda)$—Weighted blue light hazard function
$\Delta\lambda$—Wavelength bandwidth nm

- Formula 3: Blue-light weighted radiance per luminance

$$B_R = \frac{L_B}{L}$$

L_B —Blue light weighted radiance $W \cdot m^{-2} \cdot nm^{-1} \cdot sr^{-1}$
L —Luminance $cd \cdot m^{-2}$

Note: The B_R value is higher, the damage of display products is greater; the B_R value is lower, the damage of the display products is smaller

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2.1 IEC TR 62778:2014

BOE

- Background
  - ✓ Full title: IEC TR 62778:2014 Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires
  - ✓ Published by: IEC TC34 Lamps and related equipment

- Scope
  - ✓ This Technical Report brings clarification and guidance concerning the assessment of blue light hazard of all lighting products which have the main emission in the visible spectrum (380 nm to 780 nm). By optical and spectral calculations, it is shown what the photobiological safety measurements as described in IEC 62471 tell us about the product and, if this product is intended to be a component in a higher level lighting product, how this information can be transferred from the component product (e.g. the LED package, the LED module, or the lamp) to the higher level lighting product (e.g. the luminaire)

Note 1: IEC 62471:2006 Photobiological safety of lamps and lamp systems
Note 2: IEC 62471-2006 is published by IEC TC76 Optical radiation safety and laser equipment
Note 3: IEC 62471:2006 is a comprehensive horizontal standard, describing all potential health hazards associated with artificial optical radiation, from the ultraviolet, visible, and infrared portions of the spectrum
Note 4: IEC TR 62778:2014 is deals exclusively with the hazard described in 4.3.3 and 4.3.4 of IEC 62471:2006

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2.2 MEASUREMENT METHODS

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- Measurement object
  - ✓ Performance of LED point light source
- Measurement environment(s)
  - ✓ Standard measurement conditions
- Measurement Methods
  - ✓ Starting with d = 20 cm & FOV (Field of viewing) = 0.011 rad
  - ✓ Case 1: Source image underfill
    - Perform method 1: to obtain L_B
  - ✓ Case 2: Source image overfill
    - Reduce FOV angle only to make case 1 feasible, then get L_B
    - Or performing irradiance measurement with distance d = 20 cm, to get E_B, E_{thr}, d_{min}

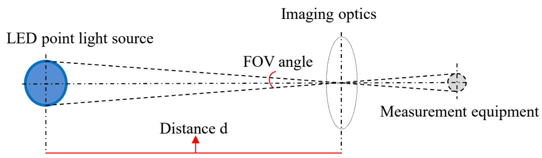

Figure 3-Method 1 measurement demo

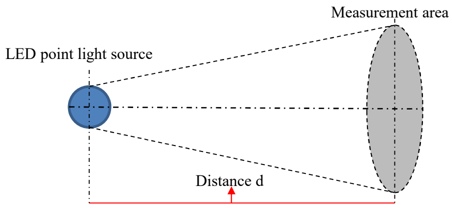

Figure 4-Method 2 measurement demo

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2.3 CRITICAL FORMULAS

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- Formula 1: Blue light weighted radiance / irradiance

$$\Phi_B = \int \Phi_\lambda \cdot B(\lambda) \cdot d\lambda$$

Φ_λ —Spectral radiance L_λ W·m⁻²·sr⁻¹ / irradiance E_λ lm·m⁻²

$B(\lambda)$ —Weighted blue light hazard function

$\Delta\lambda$ —Wavelen $K_{B,v}$ $K_{B,v}$ $K_{B,v}$ gth period

$K_{B,v}$ —Blue light hazard efficacy W·lm⁻¹

- Formula 2: Threshold illuminance

$E_{thr} = E_B / K_{B,v}$ (w/ E_B @ 1W·m⁻²·sr⁻¹)

$$K_{B,v} = \frac{\int \Phi_\lambda \cdot B(\lambda) \cdot d\lambda}{K_m \cdot \int \Phi_\lambda \cdot V(\lambda) \cdot d\lambda}$$

K_m —683 lm·W⁻¹

Φ_λ —Can be replaced by L_λ W·m⁻²·sr⁻¹ / E_λ lm·m⁻²

- Formula 3: d_{min} derivation

$$d_{min} = (I * \cos\alpha / E_{thr})^{-2}$$

I —Intensity of the source into the direction of the positon where E_{thr} is evaluated

d_{min} —Minimal distance for the source to the position

α —Angle between the light and the normal of the plane in which E_{thr} is determined

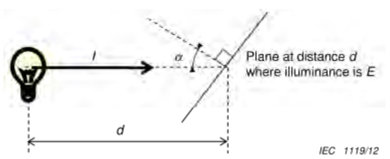

Figure 5-Illustration for formula 3

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3.1 METHODS FOCUSED COMPARISON

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Methods Focused	NP from CN-NC	IEC TR 62778:2014
Normative References	Both adopted IEC 62471:2006	
Measurement Object	Visual display terminal	LED point light source
Measurement Environment(s)	1. **Performed in dark room** 2. Temperature: 15°C ~35 °C 3. Humidity: 20 %RH to 80 % RH 4. Atmospheric pressure: 86 kPa to 106 kPa	Standard measurement conditions
Measurement Methods	1. Specified fixed measurement distances Case 1: Mobile display terminal: 30 cm Case 2: Computer monitor: 50 cm Case 3: TV: 3 x TV screen high 2. **Average values for selected 9 points** of L_b, L_B & R_B	1. Underfill: Measuring L_B with FOV = 0.011 rad and distance = 20 cm 2. Overfill: Case 1: Measuring L_B with FOV = 0.011 rad and distance = adjusted Case 2: Measuring E_B, E_{thr}, d_{min} for distance = 20 cm
Calculating Formulas	1. Blue-light radiance 2. Blue light weighted radiance 3. Blue-light weighted radiance per luminance	1. Blue light weighted radiance / irradiance 2. Threshold illuminance 3. d_{min} derivation
Other Optical Properties Measurements?	**Yes**	**NO**

3.2 OBJECT FOCUSED COMPARISON

BOE

Object Focused	NP from CN-NC	IEC TR 62778:2014
Measurement Object	Visual display terminal	LED point light source
Object Definitions	1. **DIRECTLY WATCHING purpose** 2. Display performances 3. Directional **area** light source	1. Illumination purpose 2. Blue light performance 3. Directional point light source
Application Scenario	Mobile, monitor, TV, etc.	Signal light, desk lamp, room light, etc.
Way to affect the eye	**Directly LONG TIME watching**	Primarily received by the eye indirectly: reflection & diffuse

Summary:

✓ From this slide, it is clearly that the product of visual display terminal and LED point light source are based on two **entirely different concepts**

3.3 CONCLUSION

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- The measurement objects, environments, methods and calculation formulas are totally different between NP about Blue Light from CN-NC and IEC TR 62778:2014
- Based on all evidences illustrated just before, the measurement methods of IEC TR 62778:2014 are not feasible for measuring visual display terminal. Therefore, NP about Blue Light from CN-NC is pretty critical

4.1 BRIEF OF MEASUREMENT METHOD

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- Measurement tool: Spectral radiance meter
- Testing signal: All white field signal
- Testing Samples: 8 mobile phones with eye-protection mode (all different famous brands)
  - ✓ Screen sizes are about 5.5 inches
- Formula of blue light weighted radiance L_B (Adopted with IEC 62471:2006):

$$L_B = \sum_{\lambda=300}^{700} (L_\lambda \cdot B(\lambda) \cdot \Delta\lambda)$$

L_λ ——Spectral radiance;

$B(\lambda)$——Blue light hazard weighting function;

$\Delta\lambda$ ——Wavelength period.

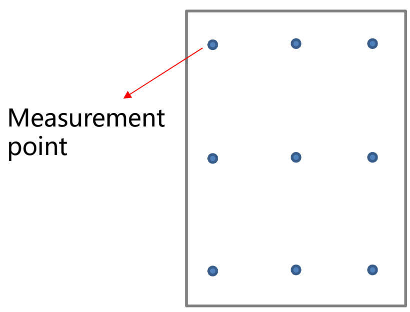

Figure 6-Measurement points

4.2 TESTING RESULTS

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□ Parameters under eye-protection mode enabled (**luminance: 120 cd/m²**):

Samples	Original Luminance cd/m²	Eye-protection Mode Luminance cd/m²	Original Blue Light Weighted Radiance $w \cdot m^{-2} \cdot sr^{-1}$	Eye-protection Mode Blue Light Weighted Radiance $w \cdot m^{-2} \cdot sr^{-1}$
A	124.3	106.2	2.15	0.483
B	119.6	76.6	2.40	0.993
C	121.3	90.6	2.33	1.06
D	120	96.7	2.19	1.26
E	118.3	100.2	2.21	1.32
F	121.3	108.1	2.34	1.45
G	125	109.9	2.36	1.49
H	123.6	112.1	2.04	1.29

Summary:
- ✓ The blue light radiance decreases under eye-protection mode enabled
- ✓ Sample A got the lowest blue light radiance after eye-protection mode enabled

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4.2 TESTING RESULTS (CONT...)

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□ Parameters under eye-protection mode enabled (**the Lowest brightness status**):

Samples	Original Luminance cd/m²	Eye-protection Mode Luminance cd/m²	Original Blue Light Weighted Radiance $w \cdot m^{-2} \cdot sr^{-1}$	Eye-protection Mode Blue Light Weighted Radiance $w \cdot m^{-2} \cdot sr^{-1}$
A	2.2	1.7	3.84	0.74
B	1.2	1	1.73	1.33
C	1.6	1.5	2.72	1.81
D	2	1.6	3.92	2.47
E	2.4	2.4	4.48	3.12
F	3.6	2.6	7.23	3.26
G	2.8	3.1	5.35	4.39
H	6.7	4.3	13.4	5.54

Summary:
- ✓ The blue light radiance decreases under eye-protection mode enabled
- ✓ Sample A got the lowest blue light radiance after eye-protection mode enabled

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THE END

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Thanks！